

New records, distribution and dispersal pathways of *Sander lucioperca* in Iberian freshwaters

by

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RÉSUMÉ. - Nouveaux signalements, distribution et voies de dispersion de *Sander lucioperca* dans les eaux douces ibériques.

Deux nouveaux signalements de *Sander lucioperca* (Linnaeus, 1758), dans les régions ouest et sud-ouest de la péninsule Ibérique (bassins hydrographiques du Tage et du Guadiana, Portugal), sont présentés. La distribution de cette espèce dans les eaux douces ibériques est actualisée, et les voies potentielles de dispersion sont déduites de l'évolution spatiotemporelle des signalements.

Key words. - Percidae - *Sander lucioperca* - Portugal - Non-native fish - Invasion pathways - Freshwaters - Reservoirs - Records.

Regardless of the increasing awareness that non-native fishes are a threat to native faunas, the number of introductions continues rising in the Iberian Peninsula (see Ribeiro *et al.*, 2008, and references therein). The endemic freshwater fish fauna of the Iberian Peninsula is now one of the most threatened in the Mediterranean basin, a situation largely associated with non-native species introductions and river impoundment-mediated habitat modifications (Smith and Darwall, 2005). Overall, 22 non-native fish species have successfully established in Iberian freshwaters, some with evidence of rapid spreading within and across drainages; moreover, at least 13 other non-native species failed to establish, whereas 10 native species have been translocated (Ribeiro *et al.*, 2008).

This paper reports new observations of the non-native *Sander lucioperca* (Linnaeus, 1758), and infers possible dispersal pathways and spreading agents in the Iberian Peninsula by reconstituting introduction and capture data.

Pikeperch individuals were collected in the Cedillo reservoir, at the international main stretch of the Tagus River ($39^{\circ}39'28''N$; $7^{\circ}14'49''W$) and in the Lucefécit reservoir, Lucefécit River, lower Guadiana drainage ($38^{\circ}38'05''N$; $7^{\circ}24'30''W$; Fig. 1) with gillnets, during fish surveys carried out between June and August 2005. Twenty-four specimens from the Cedillo reservoir and four specimens from the Lucefécit reservoir were analysed, registered and deposited in the ichthyological collection 'Museu Bocage' of the Museu Nacional de História Natural, Lisbon, Portugal (MB05-2202 and MB05-2203, respectively). Specimen identification followed Berg (1949) and Coad (2007). Meristic features and body coloration pattern of fish captured in the Cedillo and Lucefécit reservoirs lead to the unequivocal identification of these specimens as *S. lucioperca*. Specifically, the high number of soft rays in the second dorsal fin (> 18) ruled out *S. marinus*, whereas the presence of canine teeth on both jaws is characteristic of *S. lucioperca* but not of *S. vol-*

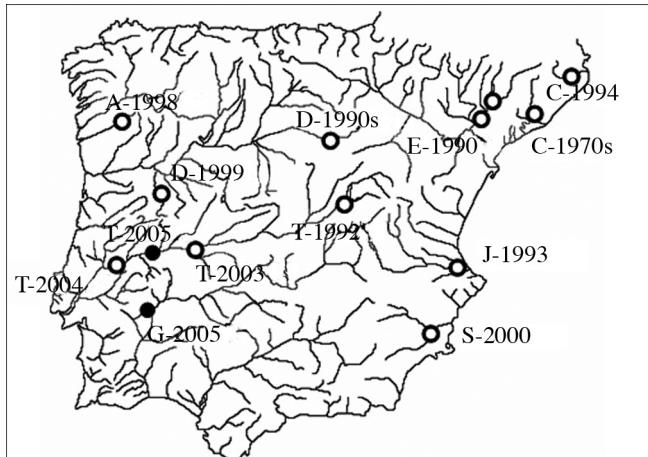


Figure 1. - Reconstruction of *Sander lucioperca* spread across the Iberian Peninsula, with year and drainages of previous records (○) and new site localities (●); C: Catalonia, E: Ebro, J: Jucárd and S: Segura (Miñano *et al.*, 2002); D: Douro, 1990 (B. Elvira, pers. com.) and 1999 (Ribeiro *et al.*, 2007); T: Tagus, 1992 (Miñano *et al.*, 2002), 2003 (Pérez-Bote *et al.*, 2004), 2004 (Ribeiro *et al.*, 2007) and 2005 (this study); G: Guadiana (this study); A: Ave, 1998 (Barros *et al.*, 2000).

gensis. Moreover, the specimens did not present the dark basal spot on pectoral fins that differentiates *S. lucioperca* from both North American species, *S. canadensis* and *S. vitreus*.

The pikeperch, *S. lucioperca* has spread west and southwards across the Iberian Peninsula over the past 30 years (Fig. 1). This species is native to central and northern Europe and was first introduced into Catalonian reservoirs, in the late 1970s (Miñano *et al.*, 2002). Twenty years later, the pikeperch was captured in reservoirs of the Ebro, Júcar, Tagus and Douro rivers (Miñano *et al.*, 2002; B. Elvira, pers. comm.) and since then it has been detected further downstream along the two latter rivers. This indicates that pikeperch has been increasing its distribution range within these drainages. Simultaneously in 1998, *S. lucioperca* was recorded in an isolated Atlantic drainage in the northwestern part of Iberian Peninsula, the Ave River (Barros *et al.*, 2000). Similarly, the southernmost occurrences in Iberian Peninsula in the Segura and the Guadiana drainages are from recent and isolated records (2000 and in 2005, respectively; Miñano *et al.*, 2002; this study, Fig. 1).

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Two main dispersal pathways likely contributed to the perceived spread of *S. lucioperca*: 1) downstream dispersal from previously colonised stretches, as observed in the Tagus and Douro Rivers; and 2) new propagules released in independent drainages, mainly into reservoirs, as occurred in the Ave River and Guadiana basin (Lucefécit reservoir). New propagules releases were probably done by local individual fishermen, since no pikeperch stocking programs were conducted by the official Inland Fisheries Agencies in either Portugal (Lourenço, 2004) or Spain (B. Elvira, pers. com.), and fishermen associations have no permission to carry out local species introductions (B. Elvira and J. Bochechas, pers. com.). These releases likely occurred in both countries in association with the growing interest in recreational fisheries, as suggested by the increasing numbers of fishing licences sold in both Portugal (Collares-Pereira *et al.*, 2000) and Spain (Ministerio de Medio de Ambiente, 2007) in recent years. Similar cross-drainage dispersal pathways, having fishermen as important dispersal agents, were previously suggested for other non-native fish used in recreational fisheries in Iberian freshwaters (Ribeiro *et al.*, 2008 and references herein). The spread of pikeperch in Iberian freshwaters would likely have biodiversity, environmental and economic impacts, as it has been the case with the other non-native species in the Iberian Peninsula (see Ribeiro *et al.*, 2008). Generally, information about non-native fish dispersal in a new region is scarce or nonexistent, limiting appropriate management actions. In this study, by reconstituting pikeperch records it was possible to identify two different dispersal pathways and spread agents. Management approaches are thus needed for both: 1) quantify species invasibility and its possible consequences to freshwater ecosystems, and 2) reduce the propagule pressure done by fishermen. Specifically, reducing the propagule pressure could be done by increasing fishermen awareness through the production and distribution of handouts about non-native fish nuisances and by active and effective law enforcement.

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REFERENCES

BARROS J.S., CUNHA M.J., LINO M., VIEIRA N. & VALENTE A.C.N., 2000. - Evaluation of the water quality and biotic communities of two Portuguese reservoirs (Alto Lindoso and Ermal) and their relationship with recreational fishing. *Verh. Int. Verein. Limnol.*, 27: 2693-2698.

BERG L.S., 1949. - Freshwater Fish of USSR and adjacent Countries. Vol. III, 510 p. Leningrad: Academy of Sciences.

COAD B.W., 2007. - Fishes of Canada's National Capital Region. Available at <http://www.briancoad.com/NCR/Percidae.htm> (accessed on 24 Feb. 2007).

COLLARES-PEREIRA M.J., COWX I.G., RIBEIRO F., RODRIGUES J.A. & ROGADO L., 2000. - Threats imposed by water development schemes on the conservation of endangered fish species in the Guadiana River Basin in Portugal. *Fish. Manag. Ecol.*, 7: 1-12.

LOURENÇO R., 2004. - Repovoamentos piscícolas em Portugal continental desde o Século XIX. 80 p. Lisboa: Instituto Superior de Agronomia.

MIÑANO P.A., OLIVA F.J. & TORRALVA M., 2002. - Primera cita de la lucioperca *Sander lucioperca* (Actinopterygii, Percidae) en la cuenca del río Segura, SE de España. *Ann. Biol.*, 24: 77-79.

MINISTERIO DO MEDIO AMBIENTE, 2007. - Anuário de Estadística Florestal. 908 p. Madrid: Ministerio do Medio Ambiente.

PÉREZ-BOTE J.L., ROSO R., PULA H.J., DÍAZ F. & LÓPEZ M.T., 2004. - Primeras citas de la lucioperca, *Sander* (=*Stizostedion*) *lucioperca* (Linnaeus, 1758) y del alburno, *Alburnus alburnus* (Linnaeus, 1758) en las cuencas extremeñas de los ríos Tajo y Guadiana, SO de la Península Ibérica. *Ann. Biol.*, 26: 93-100.

RIBEIRO F., BELDADE R., DIX M. & BOCHECHAS J., 2007. - Carta Piscícola Nacional Direcção Geral dos Recursos Florestais-Fluviatilis, Lda. Available at <http://www.cartapiscicola.org/> (accessed on 24 Feb. 2007).

RIBEIRO F., ELVIRA B., COLLARES-PEREIRA M.J. & MOYLE P.B., 2008. - Life-history traits of non-native fishes in Iberian watersheds across several invasion stages: a first approach. *Biol. Inv.*, 10: 89-102.

SMITH K.G. & DARWALL W.R.T., 2005. - The status and distribution of freshwater fish endemic to the Mediterranean basin. 31 p. Gland: IUCN - The World Conservation Union.

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